

Evaluate each expression for the given value of x . No Calc.

$$\textcircled{1} \quad 2^x, \quad x=3$$

$$2^3 = 8$$

$$\textcircled{2} \quad 4^{x+1}, \quad x=1$$

$$4^2 = 16$$

$$\textcircled{3} \quad 2^{3x+4}, \quad x=-1$$

$$2^{-3+4} = 2^1 = 2$$

$$\textcircled{4} \quad 3^x 3^{x-2}, \quad x=2$$

$$3^2 \cdot 3^{2-2} = 9$$

$$\textcircled{5} \quad \left(\frac{1}{2}\right)^x, \quad x=0$$

$$\left(\frac{1}{2}\right)^0 = 1$$

$$\textcircled{6} \quad 2^x, \quad x=-2$$

$$2^{-2} = \frac{1}{2^2} = \frac{1}{4}$$

Exponential Function - have a variable in the exponent

$x^2 \rightarrow$ polynomial, variable in the base

$2^x \rightarrow$ exponential, variable in exponent.

Basic form

$$y = b^x$$

\nwarrow exponent
 \searrow base

OR

$$y = ab^x$$

\nwarrow initial value
 $(x=0)$
 \searrow base
 \swarrow exponent

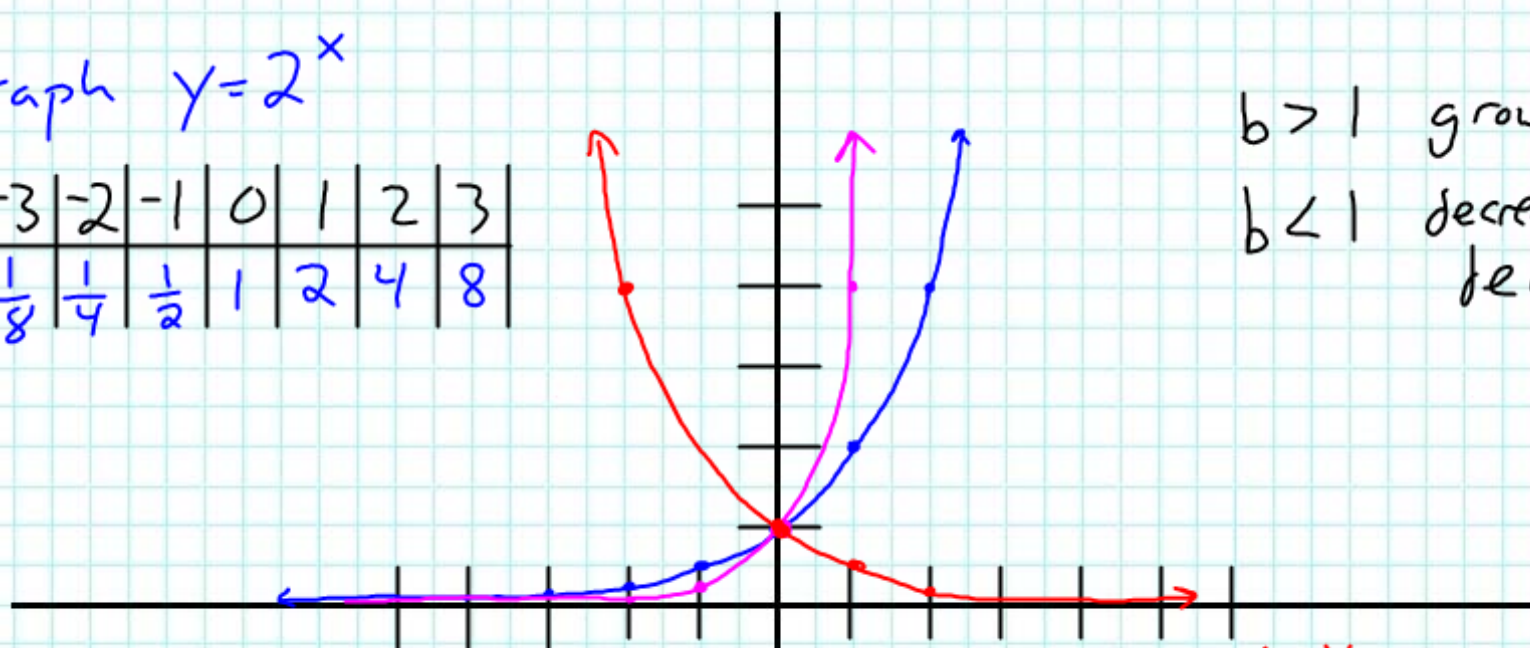
Exponential Function

$$y = ab^x, a \neq 0, b > 0, b \neq 1$$

Graph $y = 2^x$

x	-3	-2	-1	0	1	2	3
y	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	8

$b > 1$ grow
 $b < 1$ decrease
 decay



Graph $y = 4^x$

x	-3	-2	-1	0	1	2	3
y	$\frac{1}{64}$	$\frac{1}{16}$	$\frac{1}{4}$	1	4	16	64

Graph $y = \left(\frac{1}{2}\right)^x$

x	-3	-2	-1	0	1	2	3
y	8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$

Growth factor $b = 1 + r$, $r = \text{rate of increase}$

$$y = 2^x$$

growth factor doubles
• 2 each time

$$y = 3^x$$

triple
• 3 each time

$$y = 4^x$$

quadruple
• 4 each time

- Prison population at 7%. Right now there are 3,000 prisoners.

for percent growth then $b = 1 + \text{percent growth as a decimal}$

$$b = 1 + 0.07$$

$$y = ab^x$$

$x \leftarrow \text{time}$
 $a \downarrow \text{initial value}$
 $b \rightarrow \text{base}$

$$y = 3000(1 + 0.07)^x$$

in ten years

$$y = 3000(1.07)^{10} \approx 5901$$

Invest \$2,000 at 5% APR, how much money will you have in 10 years?

$$y = ab^x \quad a = 2000 \quad b = (1 + 0.05)$$

Diagram showing the substitution of values into the exponential growth formula $y = ab^x$. Arrows point from a to 2000, from b to $(1 + 0.05)$, and from x to 10.

$$y = 2000(1 + 0.05)^{10} \approx 3257.79$$

0	1	2
2000		

Writing an exponential equation (easy)

$$y = ab^x \quad (2, 2) (3, 4)$$

0	1	2	3	4
$\frac{1}{2}$	1	2	4	8
	✓	✓	✓	✓
	$\cdot 2$	$\cdot 2$	$\cdot 2$	$\cdot 2$

$$y = ab^x$$

$$y = \frac{1}{2} \cdot (2)^x$$

Steps

- ① look for the multiplier that is b
- ② work backwards to $x=0$ to find a

Writing an exponential equation (hard)

$$(1, 3.75) (6, 11.444)$$

1.) $3.75 = ab^1$

2.) $\frac{3.75}{b} = a$

3.) $y = ab^x$
 $11.444 = \frac{3.75}{b} b^6$

4.) $11.444 = \frac{3.75}{\cancel{b}} \cdot b^{\cancel{6}^5}$

$$\frac{11.444}{3.75} = \frac{3.75}{3.75} b^5$$

$$3.051733 = b^5$$

 $\sqrt[5]{\quad} \quad \sqrt[5]{\quad}$

$$\boxed{1.25 = b}$$

5.) $a = \frac{3.75}{b} \Rightarrow a = \frac{3.75}{1.25}$
$$\boxed{a = 3}$$

Steps1.) Substitute one point for x & y into $y = ab^x$ 2.) Solve for a 3.) Plug in the second point for x & y and the a -value you just found4.) Solve for b 5.) Substitute b back in to find a , use eq. from step 26.) Write the equation $y = ab^x$

$$y = 3(1.25)^x$$

Write an equation, $y = ab^x$, through $(2, 4)(3, 16)$

$$1.) y = ab^x$$

$$4 = ab^2$$

$$2.) \underline{\underline{a = \frac{4}{b^2}}}$$

$$3.) 16 = \frac{4}{\cancel{b^2}} \cdot b^3$$

$$4.) \frac{16}{4} = \frac{4b}{4}$$

$$\boxed{b = 4}$$

$$a = \frac{4}{b^2}$$

$$a = \frac{4}{4^2}$$

$$a = \frac{4}{16}$$

$$\boxed{a = \frac{1}{4}}$$

$$\boxed{y = \frac{1}{4}(4)^x}$$

Sect. 8.1

#1, 5, 10, 12, 13, 16-19, 36-38, 44, 54

www.phschool.com

age-0775

 $b < 1$ decay $b > 1$ grows $b = 1.23 \rightarrow 23\% \text{ growth}$ $b = 0.85 \rightarrow 15\% \text{ decay}$